Southern Environmental Law Center

201 West Main Street, Suite 14
Charlottesville, VA 22902-5065
434-977-4090
Fax 434-977-1483
SouthernEnvironment.org

August 11, 2017

VIA HAND DELIVERY

Mr. Joel H. Peck, Clerk
c/o Document Control Center
State Corporation Commission
Tyler Building – First Floor
1300 East Main Street
Richmond, Virginia 23219

RE: **RE:** ***Application of Virginia Electric and Power Company in re: Virginia Electric and Power Company's Integrated Resource Plan filing pursuant to § 56-597 et seq.***

Case No. PUR-2017-00051

Dear Mr. Peck:

Enclosed for filing in the above-captioned proceeding is the **Public (Redacted) Version** of the direct testimony and exhibits of James Wilson on behalf of Natural Resources Defense Council, Appalachian Voices, and the Chesapeake Climate Action Network (collectively, "Environmental Respondents"). As this filing is over 100 pages, this filing is being completed by hand delivery. Pursuant to 5 VAC 5-20-170 of the Commission's Rules of Practice and Procedure and the Hearing Examiner's Protective Ruling dated June 14, 2017, a Confidential version of this filing is being made under seal, under separate cover.

If you should have any questions regarding this filing, please call me at (434) 977-4090.

Sincerely,

William C. Cleveland

cc: Parties on Service List (electronic only)
Commission Staff (electronic only)

COMMONWEALTH OF VIRGINIA
STATE COPORATION COMMISSION

APPLICATION OF VIRGINIA ELECTRIC AND POWER COMPANY	)	Case No. PUR-2017-00051
In Reference Virginia Electric and Power Company's Integrated Resource Plan filing pursuant to Va. Code § 56-597 et seq.	)	

SUMMARY OF

DIRECT TESTIMONY OF

JAMES F. WILSON

ON BEHALF OF

ENVIRONMENTAL RESPONDENTS

August 11, 2017

Summary of the Testimony of James F. Wilson

My testimony evaluates the Company's peak load forecast and the calculation of the Total Resource Requirements used in the 2017 Plan, and provides recommendations.

I conclude that due to flawed and outdated forecasting methodology, the Company has significantly overstated its future electricity load. For example, the Company persists in forecasting 10% to 13% peak load growth over the first six years of the Plan, despite the fact that actual growth over the past six years has been flat. The Company also overstates the portion of the Dominion Zone peak load that it will serve, ignoring that the peak loads of other load-serving entities in the Dominion Zone (in particular, Northern Virginia Electric Cooperative) are growing at a much faster rate.

Importantly, the Company has not evaluated or implemented any enhancements to its load forecasting methodology, despite the chronic over-forecasting for over a decade. The Company's unwillingness to evaluate and update its methodology stands in stark contrast to industry practice. PJM Interconnection, L.L.C., for example, continually evaluates and designs potential enhancements to their load forecasting methodology, inviting suggestions from a wide body of stakeholders. I conclude that PJM's forecast, which was recently updated and predicts much less load growth in Dominion's service territory, while still conservative, is likely far more accurate than the Company's. The 2017 Plan attempts to explain the large difference between the Company's and PJM's forecasts, but this effort fails to identify even a single flaw in PJM's forecast, and also includes numerical errors.

Finally, I offer specific recommendations for the Commission to consider in future plans that should improve the Company's peak load forecasting and Total Resource Requirements planning.

COMMONWEALTH OF VIRGINIA
STATE COPORATION COMMISSION

APPLICATION OF VIRGINIA ELECTRIC AND POWER COMPANY	)	Case No. PUR-2017-00051
In Reference Virginia Electric and Power Company's Integrated Resource Plan filing pursuant to Va. Code § 56-597 et seq.	)	

DIRECT TESTIMONY OF

JAMES F. WILSON

ON BEHALF OF

ENVIRONMENTAL RESPONDENTS

PUBLIC VERSION

Confidential information has been redacted pursuant to the Hearing Examiner's Protective Ruling entered in this case on June 14, 2017.

August 11, 2017

DIRECT TESTIMONY OF
JAMES F. WILSON
ON BEHALF OF
ENVIRONMENTAL RESPONDENTS

CONTENTS

I. INTRODUCTION AND QUALIFICATIONS

Q 1: Please state your name, position and business address.

A: My name is James F. Wilson. I am an economist and independent consultant doing business as Wilson Energy Economics. My business address is 4800 Hampden Lane Suite 200, Bethesda, Maryland 20814.

Q 2: On whose behalf are you testifying in this proceeding?

A: I am testifying on behalf of the Environmental Respondents: Natural Resources Defense Council, Appalachian Voices, and the Chesapeake Climate Action Network.

Q 3: Please describe your experience and qualifications.

A: I have over thirty years of consulting experience, primarily in the electric power and natural gas industries. Many of my assignments have pertained to the economic and policy issues arising from the interplay of competition and regulation in these industries, including restructuring policies, market design, market analysis and market power. Other recent engagements have involved resource adequacy and capacity markets, contract litigation and damages, forecasting and market evaluation, pipeline rate cases and evaluating allegations of market manipulation. I also spent five years in Russia in the early 1990s advising on the reform, restructuring, and development of the Russian electricity and natural gas industries for the World Bank and other clients.

With respect to the load forecasting and capacity requirements issues I will address in this testimony, I have been actively involved in these issues in the PJM Interconnection, L.L.C. ("PJM") region for many years, participating in PJM stakeholder processes, performing and presenting analysis of these issues, and submitting affidavits in various regulatory proceedings.

I have submitted affidavits and presented testimony in proceedings of the FERC, state regulatory agencies, and U.S. district court. I hold a B.A. in Mathematics from Oberlin College and an M.S. in Engineering-Economic Systems from Stanford University. My curriculum vitae, summarizing my experience and listing past testimony, is attached as Attachment JFW-1.

Q 4: Have you previously submitted testimony in Virginia State Corporation Commission ("Commission") proceedings?

A: Yes. I submitted direct testimony on behalf of Environmental Respondents in Case No. PUE-2016-00049 last year (Virginia Electric and Power Company's 2016 Integrated Resource Plan). I also submitted direct testimony on behalf of Commission staff in Case No. PUE-2009-00043 in 2009 (Application of PATH Allegheny Virginia Transmission Corporation for Certificates of Public Convenience and Necessity).

Q 5: What is the scope and purpose of your testimony in this case?

A: This proceeding involves the 2017 Integrated Resource Plan ("2017 Plan") for Virginia Electric and Power Company ("Dominion" or the "Company"). My assignment was to evaluate the forecasts of peak loads and Total Resource Requirements included in the 2017 Plan and provide any recommendations.

II. SUMMARY AND RECOMMENDATIONS

Q 6: How are the Company's forecasts of peak loads and Total Resource Requirements used in the 2017 Plan?

A: The Total Resource Requirements ("TRR") are the Company's estimates of the amount of capacity that will be assigned to the Company by PJM for purposes of allocating capacity costs. The TRRs are calculated as the forecast peak load for the Dominion Load-Serving Entity ("DOM LSE") plus a reserve margin. As such, the TRRs represent

the Company's estimates of its customers' future generating capacity needs, and the 2017 Plan describes how the Company plans to meet these needs through owned and contracted resources.

Q 7: Please summarize the Company's approach to determining the load forecasts and TRRs.

A: The Company's approach entails the following steps.

1. Forecast the Dominion transmission zone ("DOM Zone") future peak loads;
2. Estimate the DOM LSE portion of the DOM Zone peak loads;
3. Determine the reserve margins needed above and beyond the DOM LSE peak loads;
4. Sum the peak loads and reserve margins to determine the TRRs.

Q 8: Please summarize your evaluation and conclusion regarding the Company's DOM Zone peak load forecast used for the 2017 Plan.

A: While peak loads in the DOM Zone have been quite flat over the past decade, year after year the Company persists in forecasting peak load growth well in excess of one percent per year. The past several forecasts have anticipated 10% to 13% growth over the first six years of each plan, while actual growth over the past six years has been nil. The inaccuracy of the Company's peak load forecasting has resulted in repeatedly over-stating future capacity needs (TRRs) by thousands of MW.

Q 9: Please summarize your comparison of the Company's forecasting to PJM's.

A: I have compared the Company's current forecast, and its forecasting methodology, to those of PJM, and conclude that PJM produces a superior (if still conservative) forecast based on a superior methodology. PJM's forecast is lower by over 1,300 MW in 2020, and over 2,300 MW by 2023, as shown in Table 1 below.

Q 10: The 2017 Plan acknowledges that the Company's DOM Zone forecast is well above PJM's, but identifies four adjustments to PJM's forecast that it claims close the gap. Please comment.

A: I have reviewed these claims in detail, as discussed in detail in my testimony. I conclude that none of the Company's criticisms or proposed changes is warranted or would improve PJM's forecast. In addition, some of these "adjustments" are calculated incorrectly. My conclusion that the Company's forecast is far too high, and PJM's forecast is likely to be far more accurate than the Company's, is unchanged by this section of the 2017 Plan.

Q 11: Has the Company evaluated and implemented any enhancements to its load forecasting methodology, in light of the poor recent performance?

A: No; and this should perhaps be of greatest concern to the Commission. The Company states that over the past twenty years it has made no changes to its methodology, only to the data used. The Company does not systematically conduct accuracy analyses and could not provide any documents pertaining to the accuracy of its forecasts. In particular, the Company has not even evaluated using a shorter historical period than the thirty years it has been using, a change that would allow the recent trends to have a bit more influence on the forecasts. The Company is apparently unconcerned about the chronic inaccuracy, and lacking in curiosity about how its forecasting approach could be improved.

In contrast to the Company's inaction, PJM staff are continually evaluating and designing potential enhancements to their load forecasting methodology. They apply their methodology to forecast over twenty zones, and frequently evaluate the performance of their forecasts. In these efforts, PJM staff benefit from suggestions and reactions from approximately fifty load forecasters and other experts participating in the PJM Load Analysis Subcommittee, who represent the diverse regions of the PJM footprint.

Q 12: Please summarize your evaluation and conclusion regarding the Company's forecast of the peak loads for the DOM LSE.

A: While the Company has overstated DOM Zone peak loads, the Company has also overstated the likely DOM LSE portion of current and future DOM Zone peak loads. This results from failing to recognize that the one source of peak load growth – data centers – is largely occurring in areas served by other DOM Zone LSEs (notably, Northern Virginia Electric Cooperative, or NOVEC), a fact that is difficult to discern from the 2017 Plan and the Company's responses to data requests. I have used a conservative approach to estimating the DOM LSE portion of the zonal peaks, based on the Company's data.

Q 13: Please comment on the Company's forecast of data center peak loads.

A: Both the Company and PJM adjust their DOM Zone data center forecasts upward to reflect anticipated growth in data center loads. However, the Company has used outdated data (from a 2015 report by Quanta Technologies) to represent the amount of data center growth embedded in its forecast. The Company also uses this outdated data for its long-term forecast past 2021. PJM adopts the Company's forecast of strong data center growth through 2021, but has updated its estimate of the embedded amount, and held data center peaks constant after 2021. I find PJM's approach more accurate for the near term and less speculative for the longer term. Moreover, as noted above, the Company does not distinguish the peak loads to be served by DOM LSE and other DOM Zone LSEs.

Q 14: Please summarize your conclusions with respect to the Company's reserve margin and TRR calculations.

A: For the near term (2018 to 2020), the Company has overstated its reserve requirements and TRRs by basing the reserve requirements on the amount of excess capacity cleared by PJM through its Reliability Pricing Model ("RPM") capacity construct. This is

incorrect and misleading; RPM outcomes determine cost allocations, they do not change the reserve margins needed for reliability or the TRRs.

For 2021 and beyond, the Company attempts to follow PJM's approach for its reserve margin and total resource requirement calculations, but the Company's approach is different, and some of the values used were not accurate. The results (as a percentage of peak load), however, are similar, so I used the Company's effective reserve margin for my TRR calculations for all years.

Q 15: Please present your revised peak load forecasts and TRR values.

A: Table 1 presents the results. It reflects PJM's latest forecast for the DOM Zone, a revised estimate of the DOM LSE peaks as a portion of DOM Zone peaks, and TRRs based on the effective reserve margin applied to the revised DOM LSE peaks.

My conservative estimate of the DOM LSE adjusted peak load is almost 1,300 MW lower by 2020, and close to 2,000 MW lower by 2023, than the Company's values. My conservative estimates of the Company's TRRs are over 2,000 MW lower for all years but one. My values differ even more for 2018 to 2020, for the additional reason that I reflect the reserve margin needed for resource adequacy, rather than the large amount of excess capacity cleared through RPM and improperly included in the Company's TRRs for these years.

Table 1: Load Forecast and Total Resource Requirements (MW)								
	2018	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
DOM Zone Peak Load Forecast								
2017 Plan	20,442	20,848	21,208	21,440	21,795	21,957	22,364	22,607
Based on PJM's	19,809	19,951	19,903	19,915	19,906	19,918	19,993	20,066
Difference	*-633*	*-897*	*-1,305*	*-1,525*	*-1,889*	*-2,039*	*-2,371*	*-2,541*
DOM LSE Adjusted Peak Load Forecast								
2017 Plan	17,615	17,928	18,228	18,421	18,730	18,871	19,225	19,439
Revised LSE	16,950	17,009	16,932	16,921	16,892	16,893	16,936	16,989
Difference	*-665*	*-919*	*-1,296*	*-1,500*	*-1,838*	*-1,978*	*-2,289*	*-2,450*
DOM LSE Total Resource Requirement								
2017 Plan	21,784	22,148	21,410	20,719	21,068	21,226	21,624	21,864
Revised	19,066	19,132	19,045	19,032	19,000	19,001	19,050	19,109
Difference	*-2,718*	*-3,016*	*-2,365*	*-1,687*	*-2,068*	*-2,225*	*-2,574*	*-2,755*

Q 16: Do you have recommendations with regard to peak load forecasting and TRR calculations for the purposes of future Integrated Resource Plans?

A: Yes I do. I recommend that the Commission consider requiring the following of the Company, for future plans:

1. To present recent weather-normalized peak loads for the DOM Zone and/or DOM LSE (either prepared by the Company, or by PJM), and to discuss recent trends in weather-normalized peak loads.

2. To commission a forecast of data center loads by an outside firm (as the Company did in 2013 and 2015, resulting in the reports and forecasts prepared by Quanta Technology).

3. To fully separate the forecasting of data center peak loads from the forecasting of all other customer peak loads, and to present the history and forecast of data center and other loads separately.

4. To update the estimated embedded amount of data center load reflected in the econometric forecasting annually, based on the latest information.

5. To provide an explicit forecast of the peak loads of the DOM LSE as a portion of the DOM Zone peak loads, taking into account data centers and any other sectors whose growth differs substantially for DOM LSE and other DOM Zone LSEs, with a discussion of recent trends in DOM LSE and Other LSE peak loads.

6. To present alternative load forecasts determined using 20- and 10-year historical estimation periods, in addition to the longer period currently used, and to provide a discussion of the differences and of the rationale for the choice of historical period.

7. To retain an outside consultant to perform a comprehensive review of the load forecasting methodology and make recommendations for improving accuracy.

8. To determine the TRRs using PJM's approach to these calculations (using the PJM Forecast Pool Requirement and an estimate of the DOM LSE fleet-wide forced outage rate) for all years.

These recommendations are described in additional detail in the final section of my testimony.

Q 17: How is the remainder of your testimony organized?

A: The next section reviews recent trends in peak loads in the DOM Zone, and presents the Company's and PJM's forecasts. Section IV discusses the data center forecasts and

forecast adjustments. Section V addresses the forecast for DOM LSE as a portion of the DOM Zone forecast, and Section VI discusses the reserve margin and TRR calculations. Section VII addresses peak load forecasting methodology issues, comparing the Company's and PJM's approaches. Finally, Section VIII provides conclusions and recommendations.

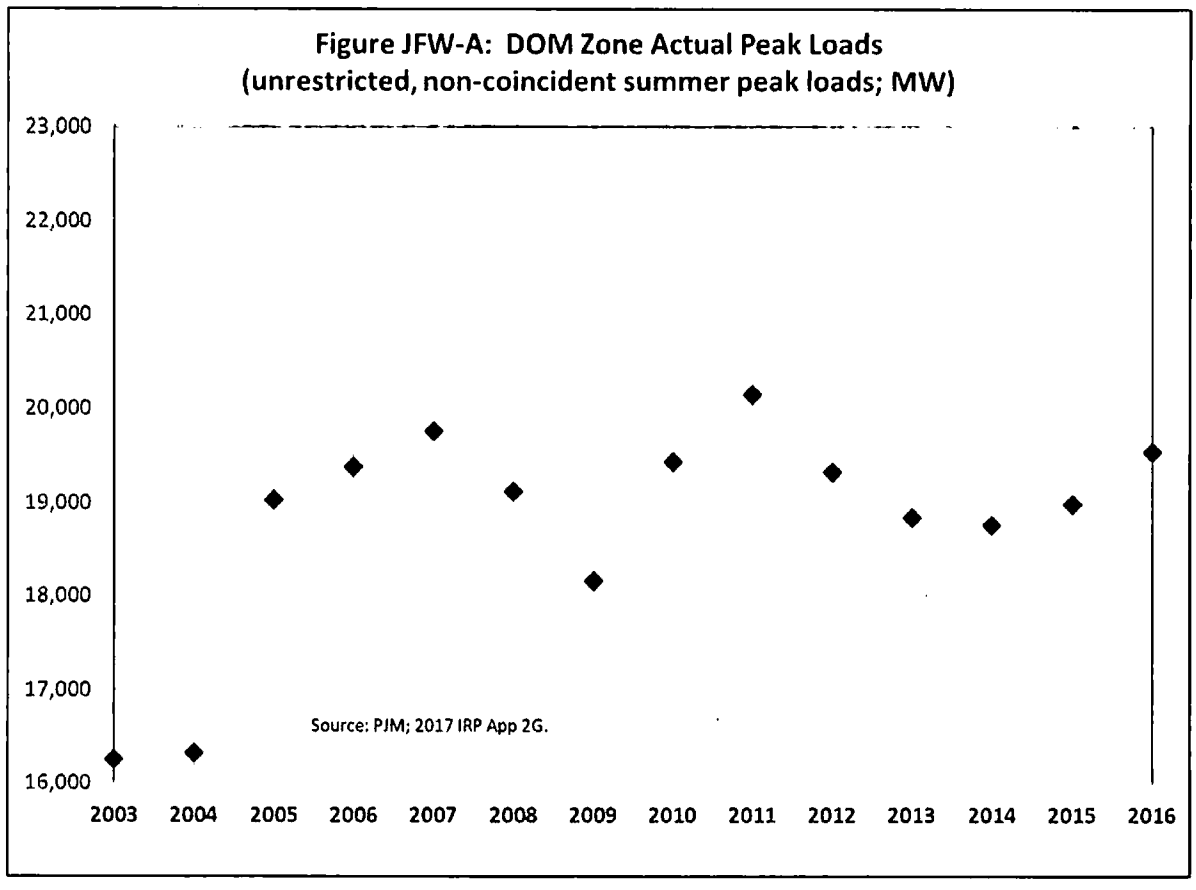
III. DOMINION ZONE PEAK LOAD TRENDS AND FORECASTS

Q 18: Please present the recent peak loads in the Dominion transmission zone.

A: Figure JFW-A presents the actual DOM Zone annual peak loads since 2003. These are the "unrestricted" peak loads, where any demand response or demand-side management by PJM or the Company that may have occurred during the peak hour has been added back.

Q 19: Please discuss any trend exhibited by these peak load values.

A: These actual peak loads do not suggest any clear trend over the past decade – for instance, the values for 2014 to 2016 are very similar to the values for 2005 to 2007. These actual peak loads reflect the actual weather that occurred each year, so they will tend to be high in years in which a very extreme period of hot or cold weather occurred, and they will tend to be low in years with only milder weather. Because actual peak loads reflect changeable weather, their pattern over relatively short periods of time may not reflect any trend, or may even be misleading, suggesting a trend that does not in fact exist.



Q 20: Is there a way to reveal the trends in past peak loads?

A: Yes. To discern the underlying trends in past energy loads, energy forecasters remove the weather impact by calculating "weather-normalized" historical values. For example, weather-normalized historical summer peak loads are estimates of what the summer peak loads would have been in past years had the weather, at the time of the summer peak load, been the typical (very hot) weather that tends to occur at the time of the summer peak load. This removes the year-to-year variability due to weather in the historical peak loads. With the year-to-year weather variability removed, the underlying, more stable trends in peak loads (due to forces such as economic and demographic growth, and changing electrical equipment stocks) are revealed.

Q 21: How do weather-normalized historical peak loads related to forecast peak loads?

A: Weather-normalized historical peaks and forecast peaks essentially represent the same values. A forecast peak load is generally intended to be a median (or "50-50") peak; that is, the peak load level that has an equal chance of being exceeded, or not being exceeded, in the future year, depending upon weather and other uncertainties. The weather-normalized historical peak is generally the same concept – it is the peak load level in the historical year that had a 50-50 chance of being exceeded due to weather variability.

Put another way, the weather-normalized historical peak load is exactly the peak load that past and current peak load forecasting efforts attempt to determine. And, accordingly, we would expect that a peak load forecast would generally be consistent with the trend reflected in past weather-normalized peaks.

Q 22: Is it a standard industry practice to calculate weather-normalized values?

A: Yes. Energy forecasters consider historical weather-normalized loads extremely useful in understanding past trends and likely future trends, and it is a standard practice to prepare estimates of past energy loads on a weather-normalized basis.

Q 23: How are weather-normalized peak loads calculated?

A: The approach usually entails modeling past energy demands, replacing the actual weather that occurred (which may have been unusually extreme, or unusually mild) with a "normal" weather pattern (including the usual magnitude and frequency of extreme weather), which may be an actual historical pattern or a synthetic one. There are many variations that can be used, and the various approaches will generally give similar results. A recent report by Itron, Inc. summarized weather normalization practices based on a

survey to which energy forecasters from 135 companies across North America responded.[1]

Q 24: Does the Company prepare weather-normalized historical peaks?

A: No. The Company states that "as a general practice, the Company does not prepare estimates of historical weather-normalized peak load."[2]

Q 25: Are weather-normalized peak loads available for the DOM Zone?

A: Yes. PJM prepares weather-normalized historical peak loads for all of it zones. PJM evaluates and revises its weather-normalization methodology, which uses its peak load forecasting model, from time to time, most recently in 2015.[3]

Q 26: Please present and discuss the recent trends in weather-normalized peak loads for the DOM Zone.

A: Figure JFW-B presents PJM's weather-normalized historical peaks for the DOM Zone.[4] The weather-normalized peak loads have been quite flat over the past decade; the 2007 and 2016 values are very close. Even in the post-recession period (from about 2010 to the present), peak loads have been flat; the 2016 and 2010 values are also very close.

Q 27: The 2017 Plan notes recent growth in data center loads (p. 25). Why hasn't this growth resulted in an upward trend in peak loads in the DOM Zone?

A: There has been strong growth in demand by data centers. However, this has only offset a declining trend in the peak loads of all other customers. Figure JFW-C includes the

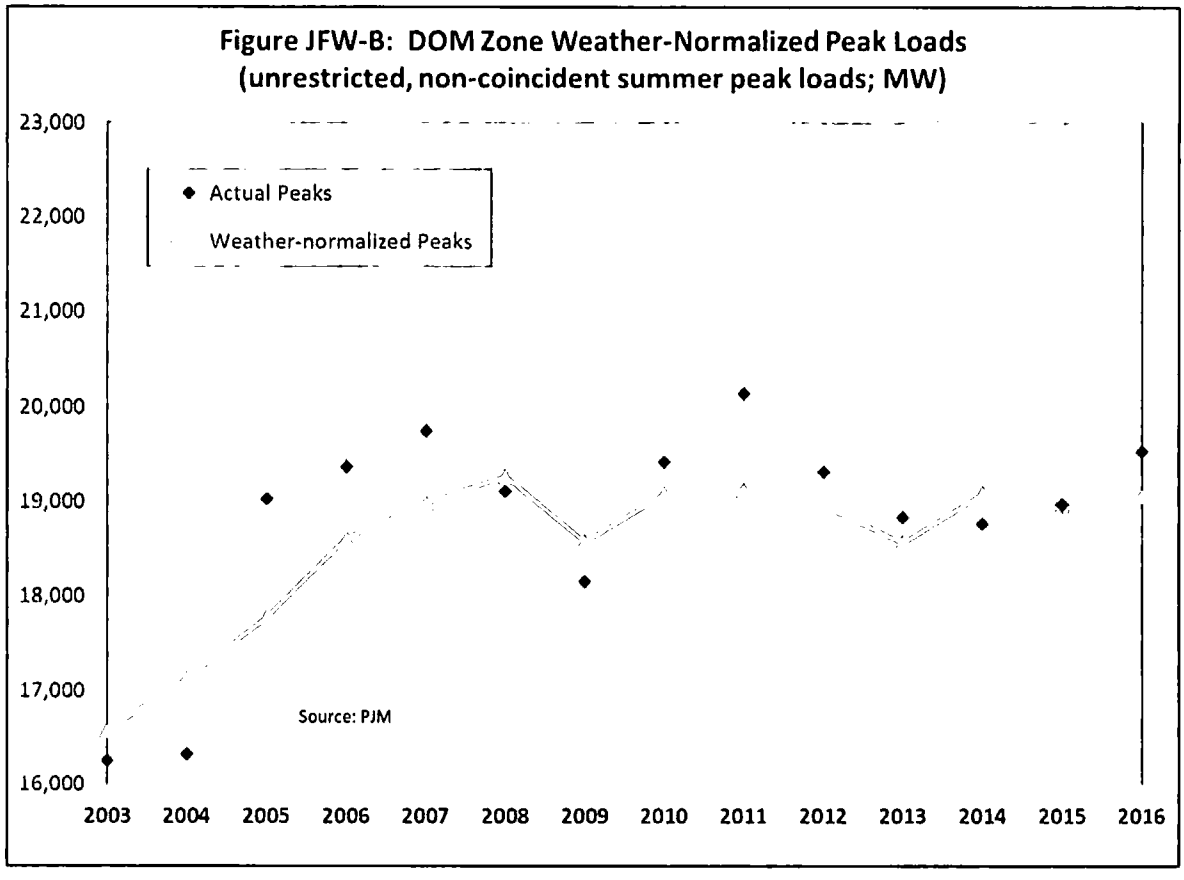
---

[1] Itron, Inc., *2013 Weather Normalization Survey*, March 2014, available at http://capabilities.itron.com/efg/Reports/Itron_WeatherNormalizationReport2013.pdf.

[2] Response to Data Request ER 1-9. All cited data requests are included in Attachment JFW-2.

[3] PJM, *Weather Normalization of Peak Load*, Load Analysis Subcommittee meeting September 2, 2015, Item 3, available at http://www.pjm.com/~/media/committees-groups/subcommittees/las/20150902/20150902-item-03-weather-normalization.ashx.

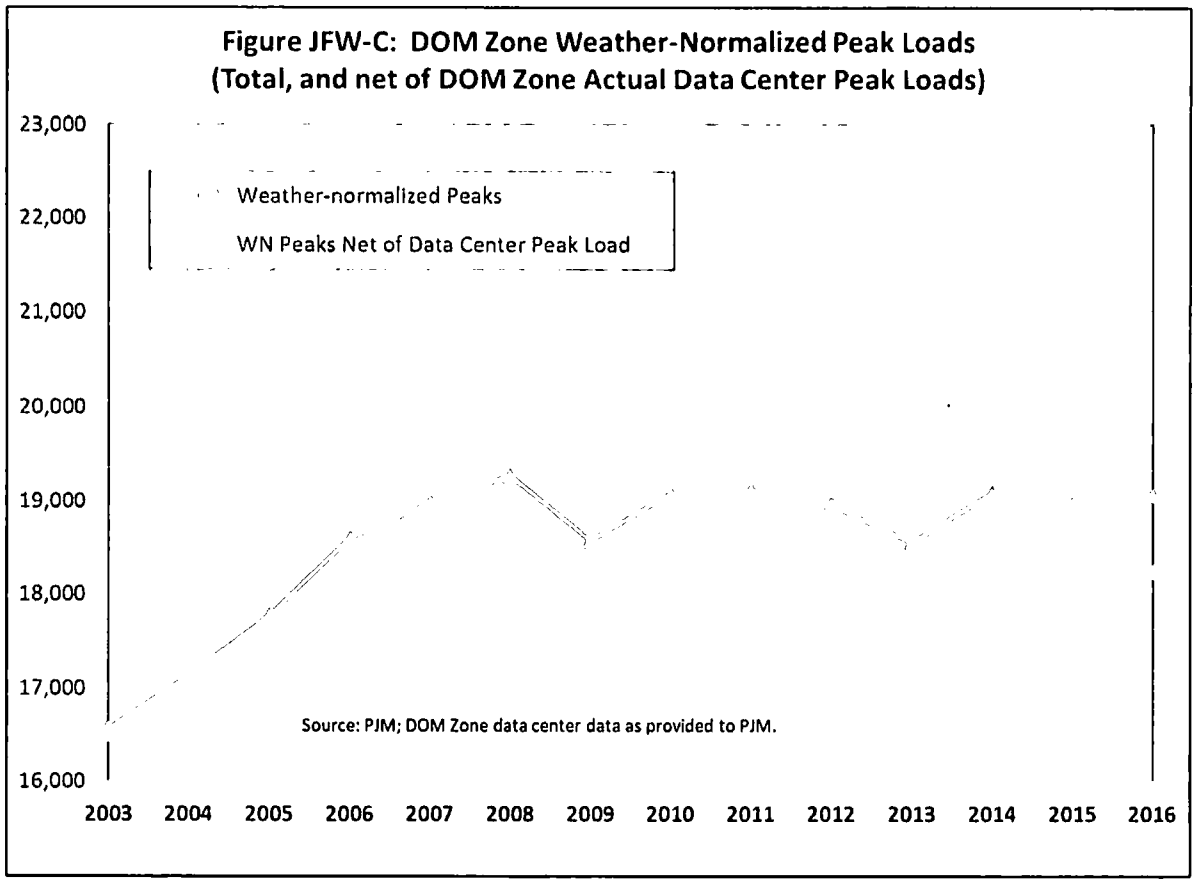
[4] PJM, *Weather Normalized Peaks*, supplemental materials to the 2017 Load Forecast Report, available at http://www.pjm.com/-/media/planning/res-adeq/load-forecast/weather-normalized-peaks.ashx?la=en.



weather-normalized peak loads for all DOM Zone loads other than the data center peak loads. The trend in the Company's peak load for all customers other than the data centers is actually down over the past decade: the weather-normalized peaks for 2015 and 2016 are lower than for 2006 through 2012. Focusing only on the post-recession period, the trend has also been down.

Q 28: Now please present the Company's peak load forecast for the DOM Zone.

A: Figure JFW-D presents the Company's forecast that was relied upon for the 2017 Plan (Appendix 2G). The summer peak loads are shown; while annual peaks have occurred in winter, this is rare, and the zone is summer-peaking on a forecast basis. As in its prior forecasts, the Company's current forecast suggests robust growth in peak loads, starting right in 2017.



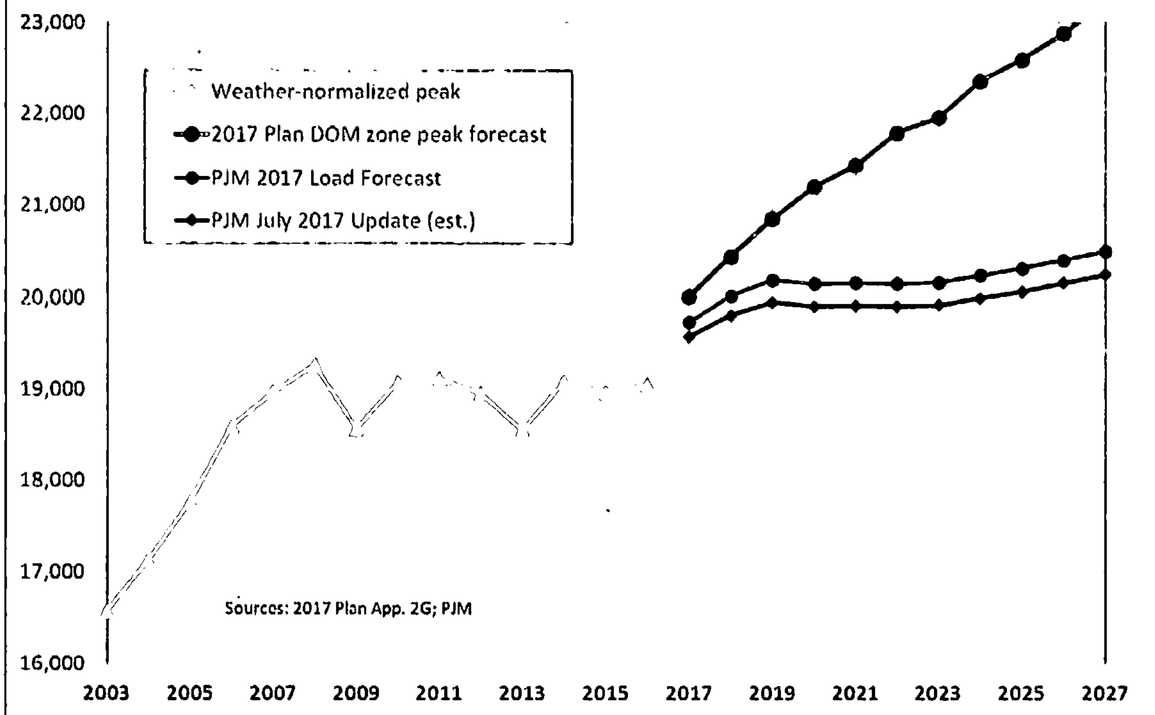
Q 29: Please describe the Company's approach to forecasting peak loads.

A: The Company uses an econometric regression model that takes some inputs from a separate model of sales by customer class.[5] The regression model forecasts peak loads based on various economic and demographic independent variables (shown in Figure 2.2.6 and Appendix 2K; forecasts from October 2016), as noted above. The methodology is described in the 2016 Plan at pp. 18-25 and is further discussed in later sections of this testimony.

Q 30: Please compare the Company's forecast to PJM's.

[5] Dominion Energy, *Electric Load Forecast Models Documentation*, June 2017, provided as Attachment ER Set 1-1(a).

Figure JFW-D: DOM Zone Peak Load Forecasts (unrestricted, non-coincident summer peak loads; MW)



A: Figure JFW-D also shows PJM's DOM Zone forecast from its 2017 Load Forecast Report[6] (published in January of 2017) and its latest forecast, based on the mid-year update in July 2017.[7] The mid-year update is based on economic and demographic projections from May 2017. For its mid-year update, PJM publishes coincident peak forecasts for 2017 through 2020; so the updated non-coincident peak forecast shown here is estimated based on the ratios of non-coincident to coincident peaks from the 2017 Load Forecast Report, which are very stable over time.

[6] PJM, *PJM Load Forecast Report January 2017*, available at http://www.pjm.com/-/media/library/reports-notices/load-forecast/2017-load-forecast-report.ashx?la=en.
[7] PJM, *Load Forecast Update – July 2017*, available at http://www.pjm.com/-/media/planning/res-adeq/load-forecast/pjm-load-forecast-update-july-2017.ashx?la=en.

PJM's forecasts are considerably lower than the Company's. PJM's January 2017 forecast is over 1,000 MW lower than the Company's for 2020, growing to more than a 2,000 MW difference by 2024. The most recent forecast, based on the latest economic and demographic projections, is even lower; more than 1,300 MW lower than the Company's forecast for 2020, and over 2,300 MW lower by 2024.

The substantial differences reflect differences in methodology, discussed further in the remaining sections of this testimony.

Q 31: Please comment on the consistency of these forecasts with recent trends.

A: As Figure JFW-D clearly suggests, the Company's forecast breaks sharply with recent trends. While peak loads have been flat, or even declining when data centers are separated, the Company forecasts strong growth. PJM's forecasts are more consistent with recent trends, but still anticipate peak load growth in the near term faster than recent trends suggest.

Q 32: You mentioned the strong growth in data center demand. Please present the forecasts, showing the data center values separate from other loads.

A: Figure JFW-E adds the forecasts for all customers other than the data centers (so the gap is the data center forecast). The Company and PJM data center forecasts are discussed later in this testimony. Figure JFW-E shows that differences in the data center forecasts do not explain the sharp differences between the Company and PJM forecasts, nor do they explain the sharp break in the Company's forecast from past trends.

Q 33: What are the primary drivers of peak load growth under the Company's forecasting methodology?

A: The Company's econometric approach relies upon various economic and demographic forecasts as independent variables that drive future peak load growth. These are

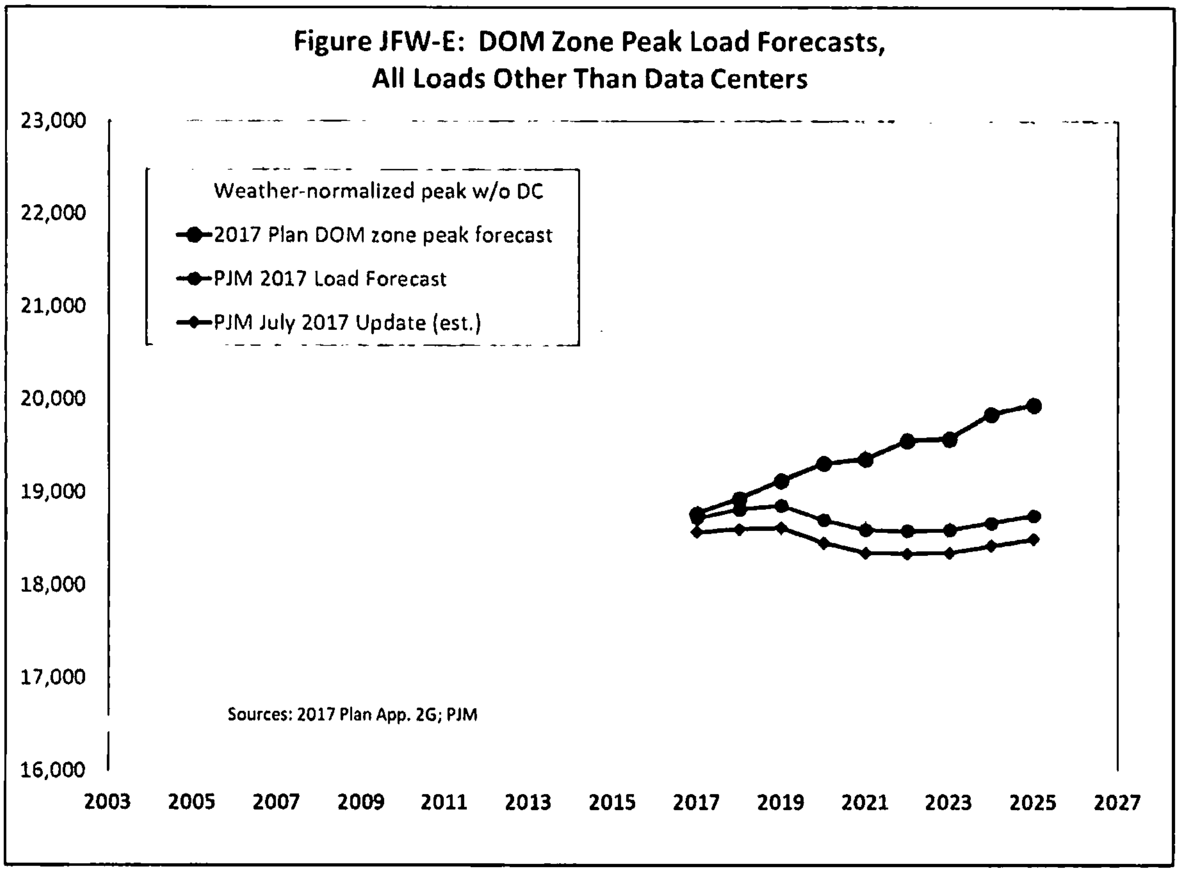


Figure JFW-E: DOM Zone Peak Load Forecasts, All Loads Other Than Data Centers

summarized in Figure 2.2.6 in the 2017 Plan, and include trends in the number of customers and households, per capita income, and employment. However, as the Company acknowledges (2017 Plan p. 24), a "key driver" is the forecast of the Virginia economy.

Q 34: The 2017 Plan states (p. 24) that the Virginia economy has been sluggish over 2008 to 2015 but that it is expected to "rebound considerably" based on Moody's projections. Does this explain the Company's forecast of a sudden change to rapid peak load growth?

A: No. The forecast growth is moderate. In addition, Moody's more recent economic and demographic projections, such as the May 2017 update reflected in PJM's July 2017 forecast, are down significantly for the DOM Zone, which partly explains why PJM's

forecast was further reduced. In any case, the connection between economic growth and peak load growth has been much weaker recently than it was a decade or more ago.

Q 35: Do the economic and demographic trends support the Company's forecast of a sharp change to robust growth in peak load?

A: No; the trends in these independent variables have been rather steady recently, and they are expected to continue to show moderate but steady increases over the forecast period, as shown in Figure 2.2.6. These forecasts do not explain the sharp deviation from trend reflected in the Company's peak load forecast.

Q 36: Is there a way to compare the economic and demographic trends and forecasts to the peak load trends and forecast?

A: Yes. A sound approach is to compute a "composite index" that combines the various economic and demographic measures into a single index. Then the history and projections of the index can be compared to the peak load history and projections.

Q 37: Has the Company prepared such a composite index?

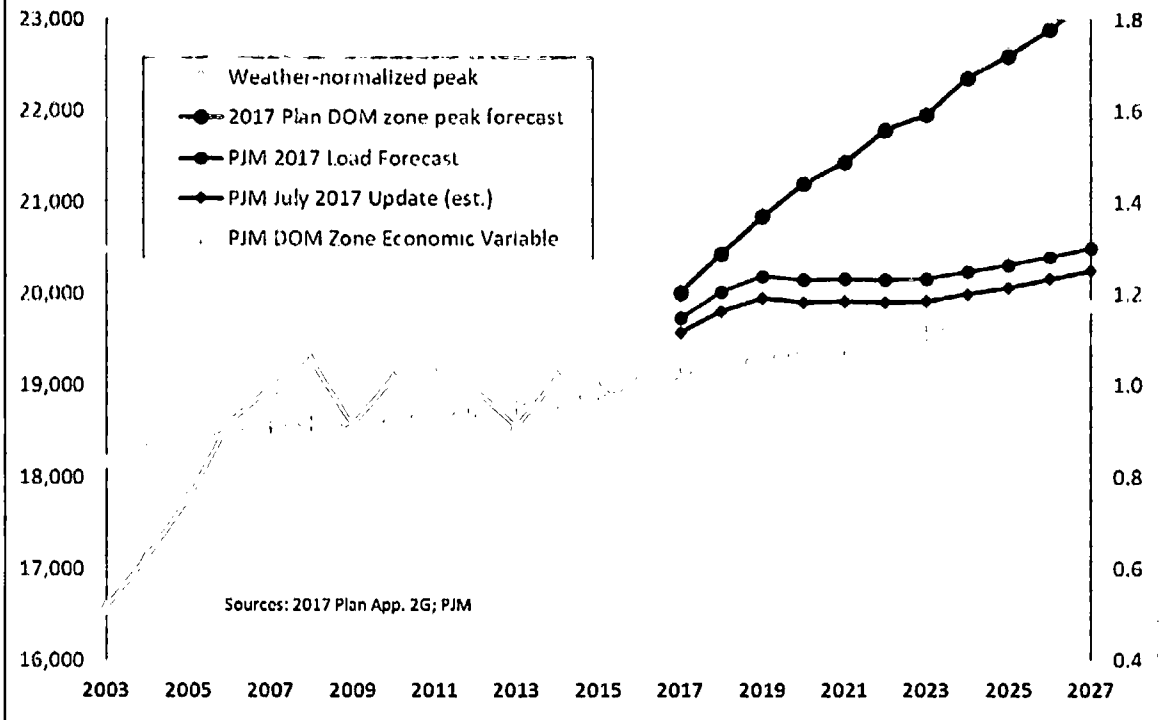
A: No. The Company has not prepared such an index,[8] and declined to prepare one.[9]

Q 38: Has PJM prepared such a composite index?

A: Yes, PJM prepares and published such indices together with its forecasts.[10] Figure JFW-F shows the composite index for the DOM Zone economic and demographic variables used by PJM in its January 2017 forecast for the DOM Zone. This index combines five DOM Zone-specific economic-demographic variables (households, population, personal

[8] Response to Data Request ER 1-19.
[9] Response to Data Request ER 9-3.
[10] PJM, *2017 Economic Variable Data*, available at http://www.pjm.com/-/media/planning/res-adeq/load-forecast/2017-economic-variable-comparison.ashx?la=en.

Figure JFW-F: DOM Zone Peak Load Forecasts and PJM 6-Part Economic Variable



income, non-manufacturing employment, and state or metropolitan product) and U.S. GDP.[11] These are the same or similar economic-demographic variables used by the Company in its forecasting, and sourced from the same vendor (Moody's economy.com).

Q 39: Please discuss how the composite economic-demographic index compares to the peak load forecasts.

A: Figure JFW-F shows that while DOM Zone peak loads were flat or declining over the past decade, the economic-demographic index continued to climb. The figure further shows that while the economic-demographic variable is expected to continue to rise in

[11] PJM, *PJM Manual 19: Load Forecasting and Analysis*, Revision: 31 Effective Date: 06/01/2016, p. 18, available at http://www.pjm.com/~/media/documents/manuals/m19.ashx.

future years, it generally continues the past trend, and does not support a sharp break with the past as suggested by the Company's peak load forecast.

Q 40: How can peak loads remain flat or decline while the economic and demographic drivers are increasing?

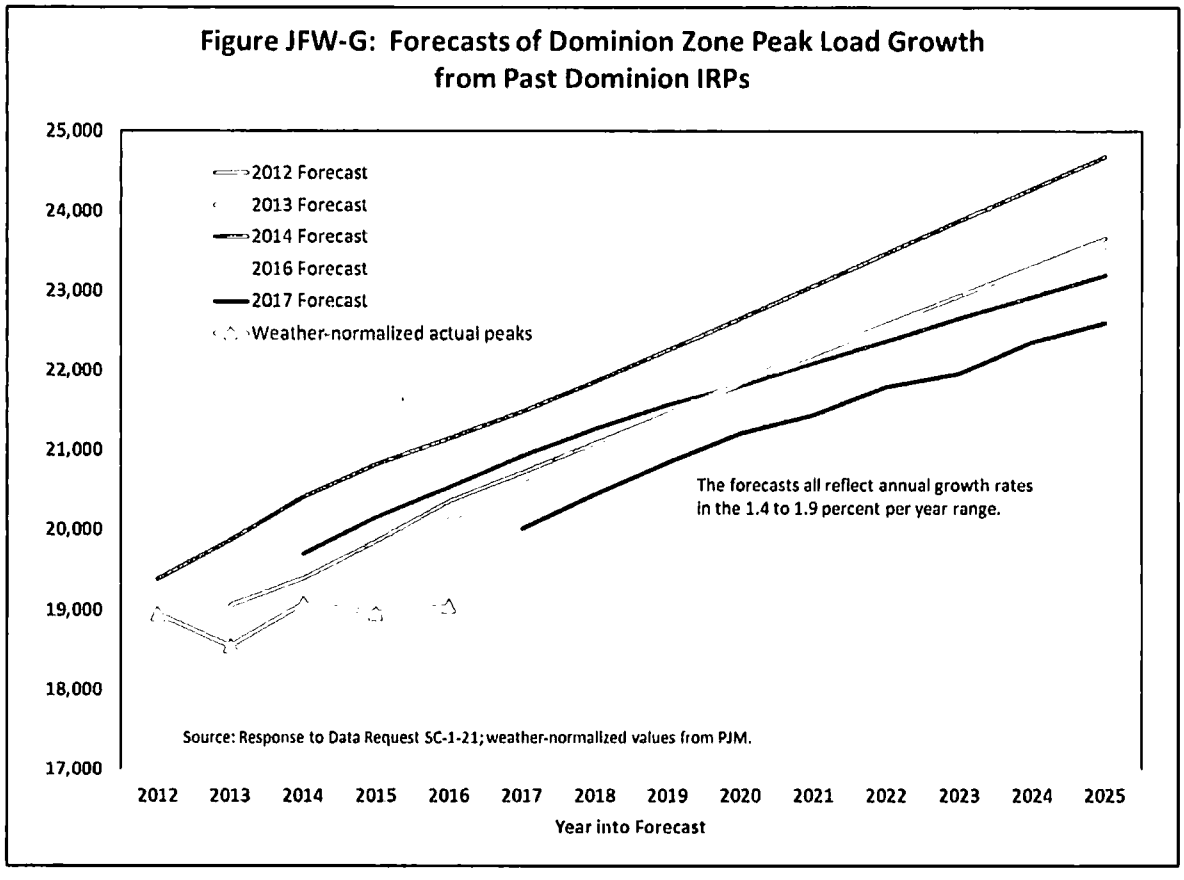
A: Peak loads can be flat or declining while economic and demographic measures rise due to the increasing penetration of increasingly energy-efficient appliances; people and businesses are doing more with electricity, while using less electricity. Later in this testimony I will further describe how PJM has enhanced its methodology to better capture this phenomenon.

Q 41: If the economic and demographic forecasts do not point to robust growth in peak loads, why does the Company's peak load forecast rise so sharply?

A: The primary reason the Company's forecasts suggest robust peak load growth is that the Company's forecasting methodology bases the forecast trends on thirty years of historical data.[12] This prevents capturing and reflecting recent trends in peak load growth, even if such trends extend for a decade, as the current trend now has.

Many years ago, the DOM Zone, and other regions of the country, did indeed experience much faster peak load growth. However, more recently, there has been a trend of slowing peak load growth, both in absolute terms, and in relation to economic and demographic growth. Including the long-ago history in the Company's forecasting leads the model to discount the more current trends from the past decade, and place undue weight on the higher rates of peak load growth seen ten to thirty years ago.

[12] Response to Data Request ER 1-5, ER 1-1.

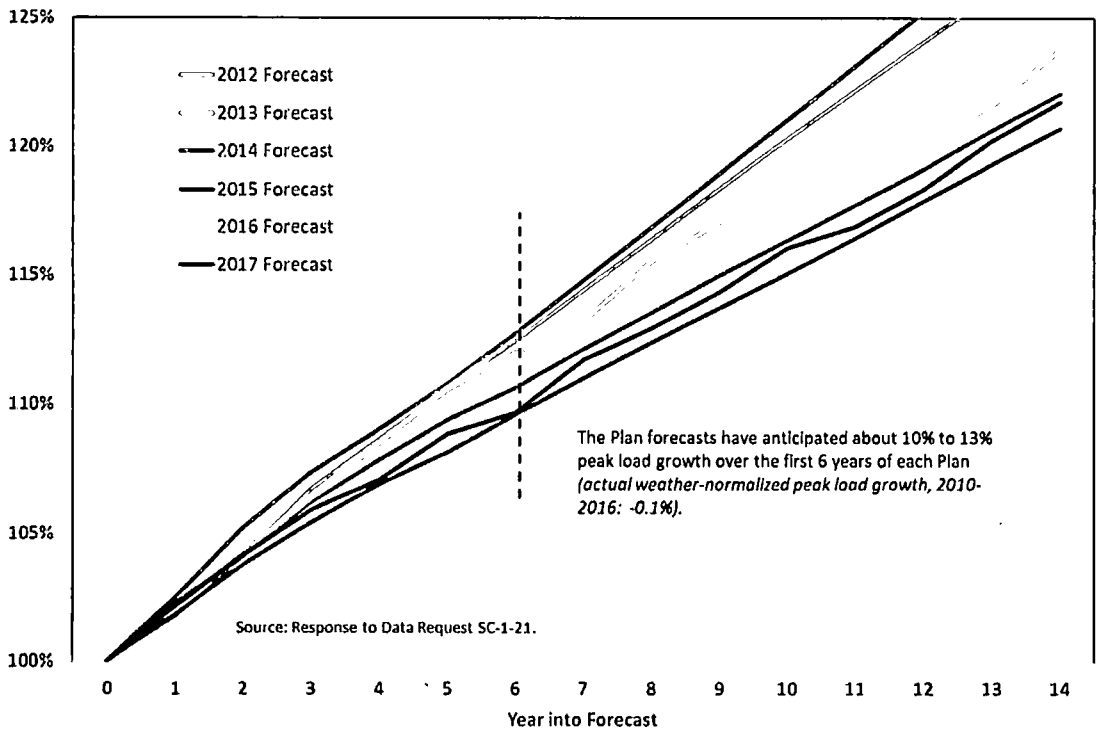


Q 42: You state that the Company's forecasting approach, based on thirty years of historical data, will result in it failing to reflect recent trends. How does the Company's current forecast compare to the forecasts in earlier Plans?

A: Figure JFW-G presents the forecasts from past Plans, along with the weather-normalized peak loads. While actual peak loads have remained flat, the Company's projections have consistently reflected growth in the 1.4 to 1.9 percent per year range.

Figure JFW-H presents the same information, with each forecast shown in percentage growth terms. The past forecasts have anticipated 10% to 13% growth over the first six years of each plan, while actual growth over the past six years has been nil.

Figure JFW-H: Forecasts of Dominion Zone Peak Load Growth from Past Dominion IRPs (Percent v First Forecast Year)



Q 43: Please summarize your conclusions from this section of your testimony.

A: The Company continues to forecast robust peak load growth for the DOM Zone, despite the decade-long trend of flat peak loads. By contrast, PJM's forecast is much lower, and much more consistent with this trend. The difference reflects differences in methodology, discussed further in a later section of this testimony.

IV. DATA CENTER LOAD FORECASTS AND FORECAST ADJUSTMENTS

Q 44: You explained that the primary source of peak load growth in the DOM Zone has been from data centers, and this growth is expected to continue. How has the Company prepared its forecast of the contribution of data centers to peak loads?

A: The Company states that it relied on its internal projections for the years 2017 through 2021.[13] For 2022 and beyond, the Company relied upon a report and forecast prepared by Quanta Technology in 2015 ("Quanta Report").[14]

Q 45: You mentioned that both the Company and PJM adjust their forecasts to take into account the anticipated strong growth in data center loads. Please explain the rationale for such adjustments.

A: The Company is concerned that its econometric forecasting approach will fail to accurately forecast the growth in data center loads, because the growth trend is fairly recent. Accordingly, it adjusts the results of its econometric load forecasting based on a separate forecast of data center loads. PJM also adjusts its forecasts in a similar way, based on information provided to it by the Company.[15]

Q 46: How are such adjustments for data center load growth determined?

A: The general approach is to 1) prepare a separate forecast of the data center peak loads, 2) estimate how much data center peak load growth is already captured in the econometric forecasting (the "embedded" amount), and then 3) determine an adjustment based on the difference between the separate data center forecast and the amount captured in the econometrics.

---

[13] Response to Data Request ER 6-2.
[14] Quanta Technology, *Dominion Northern Virginia Load Forecast Dominion Virginia Power*, Oct. 23, 2015, Provided as Attachment ER Set 1-31(a).
[15] PJM's general approach to such load forecast adjustments is documented in PJM, *PJM Manual 19: Load Forecasting and Analysis*, Revision: 31 Effective Date: 06/01/2016, Attachment B: Load Forecast Adjustment Guidelines, available at http://www.pjm.com/~/media/documents/manuals/m19.ashx.

Q 47: Did the Company determine the adjustment in this manner for the 2017 Plan?

A: No. The Company prepared an updated data center forecast, as noted above. However, the Company did not prepare a contemporaneous estimate of the data center load growth captured in the econometric modeling. Instead, the Company used an outdated estimate of the embedded amount, from the 2015 Quanta Report.[16]

Q 48: Is it important to use an updated, contemporaneous estimate of the embedded amount of the data center load captured in the econometric modeling?

A: Yes it is. Using a two year old estimate of the embedded amount, as the Company has done, results in understating the embedded amount, and double-counting some data center growth. Because the data center loads are growing rapidly, each year provides an important new data point for the econometric modeling, that should have a substantial impact on the econometric projection. Each update will change both the embedded amount and the starting point for the projection.

For example, for its 2016 load forecast, PJM estimated that its econometric model projected 800 MW of DOM Zone data center peak load for 2020; for its 2017 load forecast one year later, the embedded amount rose to 1,000 MW.[17] Using the prior estimate would have resulted in underestimating the embedded amount by 200 MW, and including an adjustment that overstates the data center load by 200 MW in 2020.

Q 49: How much of the data center load growth does the Company assume is already captured by the Company's econometric forecasting approach?

---

[16] Response to Data Request ER 5-18(a).

[17] PJM, *Load Forecast Adjustment – Dominion*, PJM Load Analysis Subcommittee meeting Item #5, December 10, 2015, available at http://www.pjm.com/-/media/committees-groups/subcommittees/las/20151210/20151210-item-05-load-forecast-adjustment-dominion.ashx and PJM, *Dominion Load Forecast Adjustment*, PJM Load Analysis Subcommittee meeting Item #8, October 19, 2016, p. 2, available at http://www.pjm.com/-/media/committees-groups/subcommittees/las/20161019/20161019-item-08-dominion-load-forecast-adjustment.ashx.

A: This is found by comparing Tables 4-5 and 4-6 from the Quanta Report, which reveals that the Company has assumed that very little of the growth is captured by its forecasting approach. Specifically, the data used by the Company suggests that only 136 MW of the data center load growth over 2015 to 2025 was captured by the Company's econometric approach (comparing the estimated embedded amounts in 2025 and 2015).

Q 50: Has the Company requested Quanta Technology to update its forecast of data center loads, and of the embedded amounts?

A: No. The Company has not requested that Quanta Technology update its analysis, and there is no such update.[18]

Q 51: Now please describe how PJM determined its data center forecast and forecast adjustment.

A: PJM relied upon the forecast provided by the Company for 2017 through 2021.[19] Beyond 2021, PJM held the data center peak load values constant, because projections were not available beyond 2021. PJM updated its estimates of the embedded amount, resulting in the forecast adjustments shown in Table B-9 of the 2017 Load Forecast Report.

Q 52: How certain are these forecasts of rapid growth in data center loads?

A: The growth is highly uncertain; it could be considerably different from the forecast in either direction. The Quanta Report notes (p. 13) that data center owners are "deliberately optimistic in giving the utility completion dates and future loads," because they want no utility-side constraints on when they can get the power they need.

---

[18] Response to Data Request ER 5-17d, e.

[19] PJM, *Dominion Load Forecast Adjustment*, PJM Load Analysis Subcommittee meeting Item #8, October 19, 2016, p. 2, available at http://www.pjm.com/-/media/committees-groups/subcommittees/las/20161019/20161019-item-08-dominion-load-forecast-adjustment.ashx,

While it may be very likely that there will be strong growth in electric demand for data centers in North America, at least in the near term, it is highly uncertain when and where that growth will occur. And a recent report by Lawrence Berkeley National Laboratory suggests that increasing energy efficiency at data centers will result in little additional growth in their electricity demands at the national level in the coming years, despite strong growth in the demand for their services:[20]

> "The combination of these efficiency trends has resulted in a relatively steady U.S data center electricity demand over the past 5 years, with little growth expected for the remainder of this decade. It is important to note that this near constant electricity demand across the decade is occurring while simultaneously meeting a drastic increase in demand for data center services; data center electricity use would be significantly higher without these energy efficiency improvements."

The Quanta Report also notes this possibility; it states that as existing and new data centers upgrade to new technologies, "their electric loads could drop substantially."[21]

Q 53: Has the Company researched whether the owners of the existing or anticipated data centers are pursuing efforts to become more energy efficient?

A: The Company states that it has not conducted formal research of this question, and has made no explicit assumption in this regard.[22]

Q 54: Haven't some of the companies that build and operate data centers also announced intentions to increasingly rely on renewable sources of energy?

---

[20] U.S. Department of Energy, Ernest Orlando Lawrence Berkeley National Laboratory, *United States Data Center Energy Usage Report*, June 2016 (LBNL-1005775), p. ES-2, available at http://eta.lbl.gov/sites/all/files/lbnl-1005775_v2.pdf.
[21] 2015 Quanta Report p. 26.
[22] Response to Data Request ER 1-34.

A: Yes, a number of these companies have announced such intentions over the past few years. These commitments are summarized in a recent report by Greenpeace.[23] This report notes (p. 30) that of five U.S. "hot spots" for data center investment, Northern Virginia ranks low, and far behind Northern California and Dallas with regard to access to renewable energy; this suggests that the firms committing to renewable energy may increasingly choose other regions of the country for their data center expansions.

Q 55: How has the Company taken such intentions into account in the 2017 Plan?

A: The Company states that only "quantifiable, proven and firm" parameters are taken into account in the integrated resource planning ("IRP") process, and that such owners' "intentions" to rely on renewable sources of energy do not constitute observable quantities, so they are not part of the IRP process or modeling.[24] However, the Greenpeace report (Appendix II: Company Scores Explained) documents announced commitments by many of the leading companies in this industry, which appear to reflect more than just intentions.

Q 56: Is the Company aware that some of the data center owners have such goals?

A: In response to a data request, the Company stated as follows in this regard:[25]

> "While not specifically aware of whether the owners of any of the existing or anticipated data centers have expressed intentions have expressed intentions [sic] to increasingly rely on renewable sources of energy, the Company is generally aware of an increased interest in renewable sources of energy expressed by all of its customer segments."

---

[23] Greenpeace, *Clicking Clean: Who Is Winning the Race to Build a Green Internet?*, June 2017, available at http://www.clickclean.org/downloads/ClickClean2016%20HiRes.pdf.
[24] Response to Data Request ER 1-35(b).
[25] Response to Data Request ER 1-35.

However, in Case No. PUR-2017-00060, the Company has proposed a voluntary 100 percent renewable energy tariff, to be designated Rate Schedule CRG (Continuous Renewable Generation). In support of the proposal, the Company's Director of Customer Rates and Regulatory, Gregory J. Morgan, recently testified as follows:[26]

> "Some large customers are setting goals to achieve 100% renewable energy within just a few years... In recent years, the Company has also completed transactions with two large data centers, the Commonwealth of Virginia, the Department of the Navy and a large university which have supported their renewable energy development goals..."

Thus, the Company has elsewhere acknowledged that some data center customers have very specific, near-term renewable goals, but nonetheless has not taken these requirements into account in its 2017 Plan.

Q 57: What is your conclusion and recommendation with respect to the DOM Zone data center peak load forecast for the 2017 Plan?

A: The Company has used outdated data (from the 2015 report by Quanta Technologies) to represent the amount of data center growth embedded in its forecast; this results in understating that amount, and some double-counting in its forecast. The Company also uses this outdated data for its long-term forecast past 2021. PJM adopts the Company's forecast of strong data center growth through 2021, but has updated its estimate of the embedded amount, and held data center peaks constant after 2021. I find PJM's approach more consistent and accurate for the near term and less speculative for the longer term.

[26] Direct Testimony of Gregory J. Morgan on behalf of Virginia Electric and Power Company, Case No. PUR-2017-00060, June 28, 2017, p. 3.

V. DOMINION LOAD-SERVING ENTITY PEAK LOAD

Q 58: Turning now to the DOM LSE peak load forecast, how was this forecast prepared for the 2017 Plan?

A: The Company determined the DOM LSE adjusted peak load forecast (Appendix 2I line 6) that is used in the TRR calculations as follows:

1. The starting point was the Company's forecast summer peak load for the DOM Zone (Appendix 2G), discussed earlier in this testimony.
2. Then the DOM LSE utility peak load "base forecast", shown in Appendix 2I line 1a, was determined as a simple percentage (87.4%) of the DOM Zone forecast in each year. This implies that Other LSEs represent 12.6% of the DOM Zone peak.
3. The DOM LSE "base forecast" was adjusted for conservation and efficiency (Appendix 2I, line 2) to determine the DOM LSE adjusted peak load forecast shown at Appendix 2I line 6 and Figure 4.2.2.1 column 5, and used for the TRR calculations.

Q 59: How did the Company determine the 87.4% factor used to represent DOM LSE as a fraction of the DOM Zone peak load?

A: The 2017 Plan states (p. 20) that this was determined based on a "monthly 10-year average percentage." The details of the calculation were provided in response to a data request.[27]

The calculation was based on the July actual peak loads for DOM Zone and DOM LSE over 2006 through 2016, so it was actually an 11-year average. The Company then assumed DOM LSE over the coming years would represent the same average fraction of DOM Zone peak load (87.4%) as it had over the eleven year historical period.

[27] Data Request ER-1-15(a) attachment.

Q 60: Is this an accurate way to forecast the DOM LSE portion of the DOM Zone peaks?

A: No. The peak loads of the Other LSEs in the DOM Zone are rising faster than DOM LSE peak loads, and represent an increasing fraction of the DOM Zone peak over time. This trend is reflected in the historical data provided by the Company in support of the 87.4% factor it is using. This trend reflects, perhaps among other factors, the strong growth in data center loads served by Other LSEs in the DOM Zone, in particular NOVEC.

Q 61: Please elaborate regarding the trend in Other LSE peak loads reflected in the Company's data.

A: To calculate the 87.4% factor, the Company used a regression over the eleven-year historical period. This regression identifies the trend toward a growing share of Other LSE peak loads, and suggests that the Other LSE share would rise from 12.4% to 14.2% by 2032.

However, to develop its forecast of the future DOM LSE peak loads, the Company ignored this trend, and simply applied the historical averages (87.4% for DOM LSE, 12.4% for Other LSE) throughout the forecast period.

Q 62: Is information available about the relative growth of DOM LSE and other LSE data center loads?

A: The Company did not provide such information, stating that it does not have information about other LSEs' data center loads.[28] The Company further states that with regard to data centers, it did not prepare a split for the 2017 Plan:[29]

[28] Response to Data Request ER 1-26.
[29] Response to Data Request ER 6-6.

"For purposes of the 2017 Plan, the Company did not breakdown the data centers by LSE and non-LSE, therefore such information is not available beyond what has already been provided in the 2015 Quanta Study."

However, some information about other DOM Zone LSEs is available from public sources. NOVEC's annual reports reveal that from 2009 to 2016, its sales grew steadily, by a total of 33% over this period (over 1,000 GWh). By contrast, DOM LSE sales grew only 0.8% over the same period, according to the 2017 Plan, Appendix 2A.

Q 63: Does the Quanta Report's forecast include data centers that are not served by DOM LSE?

A: Yes; and many of the data centers are not served by DOM LSE. In its 2015 report on the data center adjustment, PJM noted that of the nine "Category II" data centers that account for 600 MW of the forecasted growth to 2020, four are located in the NOVEC sub-area and, accordingly, are not served by DOM LSE.

Q 64: Did the Quanta Report or the Company identify the data center growth that will be served by DOM LSE?

A: No. With regard to the data and forecast in the 2015 Quanta Report, which was based on information provided by the Company and NOVEC, the Company states that it "considers the DOM Zone as a whole, and does not identify NOVEC's portion separately."[30]

Q 65: Have you prepared an alternative estimate of the DOM LSE portion of future DOM Zone peak loads?

A: Yes. I have developed two alternative estimates.

[30] Response to Data Request ER 6-5.

1. The first approach simply uses the Company's regression, discussed above, that projects the DOM LSE share to decline slowly from 87.4% to 85.8% by 2032. This has a modest impact on the forecast of DOM LSE peak loads; it reduces them by 100 MW in 2018, 200 MW in 2022, and close to 400 MW by 2032.

2. The second approach separates out the data center loads and projects the DOM LSE/Other LSE split for data centers separately. For this second approach, I used the Company's historical average (87.4%) for all other loads. For the data center loads, I used data provided by the Company to estimate the Company's portion of the data center loads.

Q 66: Please describe how you projected the DOM LSE/Other LSE split for data centers, under your second approach.

A: The Company did provide some LSE and non-LSE (NOVEC) data center details from the information provided to Quanta for the 2015 Quanta Study.[31] That data reveals that NOVEC was expected to serve [redacted] of the DOM Zone data center peak load in 2017, and of the growth expected over 2016 to 2019, NOVEC would serve [redacted] of it. Therefore, I used these percentages to assign the DOM Zone forecast data center peak loads and load growth to DOM LSE and NOVEC.

Q 67: What was the result of your second estimate of the DOM LSE peak loads?

A: My second estimate resulted in DOM LSE peak loads that were [redacted] than under the first estimate (based on the regression results) by roughly [redacted] over 2018 to 2025.

Q 68: Which of the two alternative approaches did you employ for your DOM LSE peak and TRR calculations?

[31] Response to Data Request ER 5-17 confidential attachment.

A: The second approach, separating out data centers, should be more accurate. I note that this approach would be further improved by incorporating updated data about current and anticipated DOM LSE/NOVEC data centers, but the Company has not provided such details. However, as a conservative assumption, I used the first approach based on the Company's regression for my DOM LSE peak and TRR calculations.

VI. RESERVE MARGINS AND TOTAL RESOURCE REQUIREMENTS

Q 69: Please describe how the Company calculated its Total Resource Requirements ("TRR").

A: The annual TRR values shown in Figure 4.2.2.1 were calculated as follows (references are to 2017 Plan appendices):

1. The starting point was the Company's DOM Zone peak load forecast shown in Appendix 2G and discussed in earlier sections of this testimony.

2. Then the Company determined the LSE adjusted peak load, shown at Appendix 2I line 6 and Figure 4.2.2.1 column 5, as discussed in the prior section. An adjustment for conservation and efficiency (Appendix 2I line 2) is also reflected in the LSE adjusted peak load.

3. The reserve margins, shown in the sixth column of Figure 4.2.2.1, were determined using two methods:

   (1) For 2018 through 2020, the reserve margin values were based on the capacity commitments through PJM's Reliability Pricing Model capacity construct, which has cleared an excess in each of these years.

(2) For 2021 and beyond, the reserve margin was determined by multiplying the DOM LSE adjusted peak load (step 3 above) by an "effective reserve margin" combining two components:

(a) a "coincidence factor", to estimate the DOM LSE PJM RTO-coincident peak load based on the non-coincident peak load; and

(b) PJM's recommended installed reserve margin for 2020/2021 (16.6%). The resulting effective reserve margin was 0.1248 (0.9647 x 1.166 – 1).

4. Finally, the Total Resource Requirement for each year was the sum of the DOM LSE adjusted peak load and the reserve margin. The Total Resource Requirement is expressed in installed capacity terms.

Q 70: Does the Company's approach to calculating reserve margins and capacity needs match how capacity obligations are determined in PJM?

A: No. Capacity obligations in PJM are determined beginning with PJM's forecast of coincident peaks (Table B10 in its load forecast reports), and by applying the Forecast Pool Requirement ("FPR") to the coincident peaks to determine capacity obligations on an "unforced" capacity ("UCAP"), as opposed to installed capacity, basis.[32]

In contrast, the Company used the installed reserve margin to determine capacity obligations. The Company used a single value for the installed reserve margin (16.6%) for all years, while the PJM study that identified this reserve margin recommended values by year through 2025, and the reserve margin and FPR values vary over time. In

[32] PJM, *Planning Period Parameters for the 2020-2021 Base Residual Auction*, tab 2020-2021 Parameters (showing that the Reliability Requirement is calculated based on the FPR, and the installed capacity reserve margin is used only in the calculations of the shape of the VRR curve), available at http://www.pjm.com/-/media/markets-ops/rpm/rpm-auction-info/2020-2021-bra-planning-period-parameters.ashx?la=en.

addition, the Company used a single coincidence factor (averaged over 2017-2020) for all years, to estimate coincident peaks. PJM forecasts coincident and non-coincident peaks by year, so the coincidence factor varies from year to year.

Q 71: Were you able to apply the correct approach to determining PJM capacity obligations?

A: No. To apply the correct approach would require a fleet-wide forced outage rate or unforced capacity measure for the Company's fleet, and the Company has no such measure for its resources.[33]

However, while the Company's approach differs from PJM's, the results are likely very similar.

Q 72: Have you calculated the Total Resource Requirements based on the load forecast and reserve margin values you recommend?

A: Yes I have. My estimates of the TRR values reflect the following differences from the Company's estimates:

1. I used PJM's latest DOM Zone forecast (July 2017), as discussed in an earlier section of this testimony.
2. I re-estimated the DOM LSE peak load using the Company's regression for this purpose, as described in an earlier previous section of this testimony, and applied the same conservation and efficiency adjustment.
3. I applied the Company's effective reserve margin values to determine the reserve margin and TRR in all years.

[33] Response to Data Request ER 1-47(b).

The results of the calculation were shown above in Table 1.

Q 73: The 2017 Plan states (p. 53) that the Company, as a PJM member and signatory to PJM's Reliability Assurance Agreement ("RAA"), is obligated to own or procure sufficient capacity to maintain overall system reliability. Is it correct that the RAA obligates the Company to own or procure capacity?

A: No. PJM acquires commitments to provide the capacity needed for resource adequacy through its Reliability Pricing Model ("RPM") capacity construct. The RAA assigns capacity responsibility for the purpose of allocating RPM costs to zones and to LSEs. However, the RAA does not obligate the Company (or any other party) to own or procure capacity; its references to "capacity obligations" ultimately have to do with cost allocation, as the Company acknowledges.[34] Indeed, many LSEs in PJM do not own capacity or have capacity under contract.

Q 74: The 2017 Plan also states (p. 55) that the TRRs represent "the Company's total resource need that must be met through existing resources, construction of new resources, DSM programs, and market capacity purchases." Is this an accurate characterization of what the TRRs represent?

A: No. Again, capacity obligations in PJM have only to do with cost allocation. This interpretation is especially erroneous with respect to the Company's TRR calculations for 2018 to 2020, which have been inflated to reflect cleared excess capacity through RPM. That excess does not affect the amount of capacity needed for resource adequacy, which is what the TRR represent.

Q 75: The 2017 Plan (p. 54) also identifies an "upper bound reserve margin", and states that the Company "may be required" to meet this reserve margin in the future. Is this correct?

[34] Response to Data Request ER-1-41c.

A: No. Again, PJM does not require acquisition of capacity or any particular reserve margin. The relevant calculations are only for purposes of cost allocation.

The Company calculates this higher reserve margin noting that RPM has often resulted in total capacity commitments in excess of reliability targets. But this is merely a result of the sloped RPM capacity demand ("VRR") curve used in the RPM auctions. The sloped VRR curve ensures that when capacity is relatively scarce and costly, RPM's auctions will result in a relatively low amount of committed capacity and high capacity prices; and when capacity is relatively abundant and low cost (as it has been in recent years), RPM will result in a total amount of committed capacity in excess of resource adequacy targets, and relatively low capacity prices. This approach sends a price signal about the need for capacity.

Q 76: Would it be prudent for the Company to plan for the higher reserve margins that often result from the RPM auctions?

A: No, that would not be prudent, and it would make no sense. When RPM results in excess committed capacity, this occurs at a relatively low capacity price, signaling that capacity is abundant and incremental capacity is not needed. Under such circumstances, while the nominal amount of capacity to be allocated to zones and LSEs is higher, the total capacity cost to be allocated is actually much lower. To the extent market participants expect RPM to result in excess capacity at low cost, it would make more sense for market participants to react to such a situation of abundance by planning relatively less, not more, capacity.

Q 77: Please explain how the total capacity cost is actually lower when RPM clears excess capacity.

A: Consider the following example, using the parameters from the RPM base residual auction for the 2019-2020 delivery year. If RPM cleared at the target reliability requirement, the clearing price would be $434.46/MW-day and the total market cost would be $25 billion. If instead, as actually occurred, RPM clears a large excess at $100/MW-day, the total market cost would be closer to $6 billion (ignoring higher prices in some zones). Thus, when RPM clears excess capacity, it results in less, not more capacity cost allocated to Dominion and other LSEs.

VII. THE COMPANY'S AND PJM'S LOAD FORECASTING METHODOLOGIES

Q 78: What topics will you address in this section of your testimony?

A: I will explain why traditional econometric approaches to forecasting future peak loads, which both the Company and PJM have used for many years, have resulted in chronic over-forecasting in recent years. I will further explain that PJM's updated methodology, following various enhancements designed and implemented in 2015, is still likely to be conservative, but will be more accurate than the Company's methodology. Finally, I will discuss the comparison of the Company's and PJM's DOM Zone forecasts included in the 2017 Plan at pp. 25-29.

Q 79: Please describe PJM's approach to forecasting peak loads for the DOM Zone and compare it to the Company's approach.

A: PJM also uses an econometric approach based on similar economic and demographic forecasts. While there are numerous differences between the Company's and PJM's econometric models (of which some are described in the 2017 Plan at pp. 25-29), two are likely the most important factors leading to the different results:

1. PJM uses an 18-year historical period for estimating the model, while the Company uses 30 years. As a result, PJM's forecast will reflect recent trends to a somewhat greater extent.

2. PJM's methodology has recently been enhanced to better capture trends in appliance saturation and energy efficiency (discussed further below).

Q 80: Please explain why recent peak load forecasts have generally been too high.

A: A key reason for over-forecasting has been inaccuracy in the underlying economic forecasts. Econometric forecasting approaches rely on forecasts of economic conditions (for the DOM Zone, primarily forecasts of growth in the Virginia economy) as the primary driver of growth in future peak loads. These forecasts have proven to be overly optimistic, as growth in the Virginia economy, and in the U.S. and world economies more broadly, has been slower than expected, both during the recession that began in around 2008 and also in the post-recession period.

For example, the 2017 Plan anticipates the Virginia economy will grow at a compound annual rate of 2.04% over the coming fifteen years (Figure 2.2.6, p. 24). However, last year this forecast was 2.09%, and as recently as 2013 for the 2013 Plan, the anticipated annual growth rate was 2.4% (2013 Plan Figure 2.2.4, p. 23).

Q 81: Please elaborate on how economic forecasts are the primary driver of peak load growth in econometric forecasting models.

A: While these models include other independent variables, the primary driver is generally economic growth. Econometric approaches assess how peak loads have risen with economic growth in the past, and then assume a similar relationship will hold in the future.

For example, if the economy in a zone grew by 40% over the past thirty years, while peak loads grew by 30%, this suggests peak loads grow at about 75% of the rate of economic growth (that is, an elasticity of peak load growth to economic growth of 0.75, 30%/40%). So if the economic forecast suggested economic growth would be 20% over the coming ten years, the econometric approach would anticipate peak load growth of roughly 15% over that period (20% x 0.75). While econometric approaches are more complex than this example, this is the fundamental structure.

Q 82: Please summarize the recent economic forecasts used by the Company and PJM for forecasting the DOM Zone.

A: Both the Company and PJM have used economic forecasts provided by Moody's. During the recession that began in around 2008, and for a few years following the recession, Moody's expected a very robust recovery in the U.S. economy. However, this did not occur; instead, post-recession growth has been modest. More recently, the Moody's forecasts have anticipated continued, modest economic growth going forward.

Q 83: If economic growth, and forecasts of future economic growth, have stabilized in recent years, does this mean the current econometric forecasts should be more accurate?

A: This should reduce the impact of the main cause of recent over-forecasting. However, the inaccurate economic forecasts have not been the only cause of over-forecasting. As shown earlier in this testimony, peak loads have remained flat or fallen while the economic-demographic measures have continued to rise. PJM has recently identified that this is due to the increasing efficiency of electricity use, which has not been captured by the econometric forecasting approaches.

Q 84: Please elaborate on how PJM staff came to the conclusion that the increasing efficiency of electricity use was not being captured by PJM's peak load forecasting methodology.

A: In the first few years following the recession, PJM staff believed the over-forecasting was due to the inaccurate economic forecasts, and that, removing this source of error, their forecasting approach was accurate. However, in around 2014, PJM staff determined that the economic forecasts no longer explained the forecast error, and began an internal effort to determine causes and design solutions. In March 2015, PJM staff initiated a process to discuss the problem and its proposed solutions with PJM stakeholders through the PJM Load Analysis Subcommittee ("LAS").

Q 85: Was PJM able to identify enhancements to its forecasting approach that will improve its accuracy?

A: Yes. PJM evaluated a number of potential enhancements, and identified a few enhancements that can be expected to improve accuracy. PJM evaluated the accuracy of its forecasting with the recommended enhancements using various historical periods across the many zones that it forecasts, and showed that the proposed enhancements improve accuracy. See, for instance, slides 46 to 54 of PJM's presentation to LAS on September 2, 2015.[35]

Q 86: What was the result of this work by PJM staff and the LAS?

A: PJM's recommended enhancements to its load forecasting methodology were endorsed by the PJM Markets and Reliability Committee at its November 19, 2015 meeting with no objections. The enhancements were reflected in the forecast documented in the 2016 PJM Load Forecast Report (January 2016).

Q 87: Please describe the main enhancements PJM made to its forecasting methodology in 2015.

[35] PJM, *Updates To Load Forecast Methodology*, Load Analysis Subcommittee September 2, 2015, available at http://www.pjm.com/~/media/committees-groups/subcommittees/las/20150902/20150902-item-04-forecast-update.ashx

A: The two most important changes were as follows:

1. New independent variables to capture past regional trends and forward-looking forecasts of equipment and appliance efficiency and penetration. These variables are prepared by Itron, Inc. based on U.S. Energy Information Administration ("EIA") data.

2. Improvements to the use of weather splines, to more accurately represent the relationship between weather and loads during periods of extreme weather and high loads.

Q 88: With these enhancements, do you expect PJM's forecasts will no longer consistently over-forecast future peak loads?

A: Yes. These enhancements will improve the accuracy of PJM's forecasts and reduce the over-forecasting.

Q 89: Does PJM continue to review its methodology and explore additional possible enhancements?

A: Yes. For example, this year PJM staff are reviewing their approach to forecasting winter peak loads, with the benefit of the extreme cold experienced during 2014 and 2015.

Q 90: Does the Company also evaluate and enhance its load forecasting methodology over time?

A: Apparently not. In response to a data request asking about enhancements to the methodology over the past twenty years, the Company noted no changes to its methodology, only to data (a 2016 update to appliance saturation and intensity data).[36] The Company also states that it does not systematically conduct accuracy analyses or

[36] Response to Data Request ER 1-2.

studies of its previous forecasts, and could provide no documents pertaining to the accuracy of its forecasts.[37] In particular, the Company states that it has not evaluated using a historical period shorter than the 30 years it has been using, but provided no reason for not exploring alternative historical periods other than to maintain "consistency."[38]

Q 91: You noted that the 2017 Plan discusses the Company's peak load forecast compared to PJM's (pp. 25-29) and you have reviewed this discussion. Please summarize your review.

A: The discussion at pp. 25-29 purports to identify four changes to PJM's forecast that close the gap between the Company's and PJM's forecasts. I have reviewed these claims in detail. My review can be summarized as follows:

1. The adjustments for data centers and DERs are not warranted and would not be an improvement to PJM's methodology, even if correctly applied (which they were not; both adjustments reflected errors).

2. While there is always potential for improvements to the forecasting of appliance saturation and efficiency, the Company's "adjustment" apparently removes this important enhancement to PJM's approach. This too would not be an improvement.

3. Separately forecasting the Public Authority sector could potentially improve a load forecast; however, the Company provides no explanation of why it would, and its forecast adjustment embeds a huge increase in government loads at a time when the current administration has announced intentions to reduce government.

[37] Response to Data Request ER 1-4.
[38] Response to Data Request ER 1-7a,b, Data Request ER 1-8.

I conclude that none of these proposed adjustments is warranted or would improve PJM's forecast. My conclusion that PJM's forecast is likely to be far more accurate than the Company's is unchanged by this analysis.

Q 92: Lets examine the four differences in turn. First, the Company takes issue with PJM's data center forecast. Please summarize how PJM determined this forecast.

A: PJM used the values provided to it by the Company for the 2017 through 2021 period.[39] The values for 2017 to 2021, as provided by the Company and used by PJM, reflect strong growth in data center demand. Beyond 2021, PJM chose to hold the data center forecast constant at about 1,560 MW, because projections beyond that year were not available. The Company only criticizes PJM's approach for the period beyond 2021.

Q 93: The Company asserts that by holding the data center forecast constant after 2021, PJM has made a "significant change" to its data center forecast. Is this correct?

A: No. The changes to the forecast were not large. For 2021, the updated data center forecast is 30 MW lower than the prior forecast.[40] For 2029, the updated forecast is about 400 MW lower than the prior forecast.

Q 94: Is the Company able to provide any firm evidence of any new data centers or expansions in 2021 or later years?

A: No. The Company states that it is "not in possession of specific or firm evidence of specific new data centers or data center expansions in 2021 or later years."[41]

---

[39] PJM, *Dominion Load Forecast Adjustment*, PJM Load Analysis Subcommittee meeting Item #8, October 19, 2016, p. 2, available at http://www.pjm.com/-/media/committees-groups/subcommittees/las/20161019/20161019-item-08-dominion-load-forecast-adjustment.ashx.

[40] PJM, *Load Forecast Adjustment – Dominion*, PJM Load Analysis Subcommittee meeting Item #5, December 10, 2015, available at http://www.pjm.com/-/media/committees-groups/subcommittees/las/20151210/20151210-item-05-load-forecast-adjustment-dominion.ashx.

[41] Response to Data Request ER 8-5.

Q 95: The Company claims that in developing its sales and load forecast, it "takes into account only quantifiable, proven and firm parameters."[42] Is the Company consistent with this principle, with regard to its data center forecast?

A: No. To assume additional data center load growth beyond 2021 would be speculative at this time; there is nothing proven or quantifiable about such potential load. While data centers likely will continue to expand, they will also become increasingly more energy efficient, as discussed earlier in this testimony.

Q 96: Now please comment on the Company's adjustment to PJM's forecast with regard to data centers (2017 Plan Figure 2.3.2).

A: The Company only criticizes PJM's data center forecast for the period after 2021; which makes sense, since for 2017 through 2021, PJM used the forecast provided by the Company. Yet the Company has adjusted PJM's forecast not just for years past 2021, but for all years, beginning in 2017 (as is clear from Figure 2.3.2).

The workpapers for Figure 2.3.2 reveal the nature of the error.[43] The Company removed only the adjustment PJM had applied to its forecast, and then added the Company's adjustment. This is incorrect, because the embedded amount in PJM's forecast is much greater than the assumed embedded amount in the Company's forecast. This error results in double-counting a large portion of the forecast data center load starting right in 2017.

Importantly, this error, which first appears in Figure 2.3.2, is carried forward in the subsequent adjustments shown in Figures 2.3.3, 2.3.4 and 2.3.5.

Beyond 2021, in addition to this double-counting, the Company replaces PJM's forecast with its forecast. In an earlier section of my testimony I explained that the Company's

[42] Response to Data Request ER-1-35(b).
[43] Responses to Data Requests ER 1-23 and ER 8-6.

forecast is outdated and speculative, and PJM's forecast is more reasonable, for these years.

Q 97: Second, the Company criticizes PJM's reflection of Distributed Energy Resources ("DERs") in its forecast. Please describe PJM's approach to DERs.

A: PJM commissions studies by IHS Energy to guide its forecasts of DERs, primarily behind-the-meter solar.[44] These are resources that are not connected to the grid and that net directly with loads, so they are not visible to PJM or the electric distribution companies. PJM reduces these forecasts to reflect their likely performance during peak periods (to only 27% of nameplate capacity, in the DOM Zone[45]), and includes the amounts in its forecast as a load adjustment. These load adjustments are shown in the 2017 Load Forecast Report, Table B-8.

Q 98: How did PJM develop its approach to DERs?

A: PJM developed its approach in consultation with IHS Energy and its Load Analysis Subcommittee. The approach was developed, presented, refined and discussed over five meetings between September 2, 2015 and November 18, 2016.

Q 99: What is the Company's objection to PJM's approach?

A: The 2017 Plan takes the position that DERs should not be reflected in the forecast at all, stating as follows (p. 26):

> "However, by netting out the actual and forecasted values of DER, the actual or true load is masked. As a result, the generation and transmission systems needed

[44] IHS Energy, *Solar PV Capacity Additions Forecast for PJM States: 2017–32*, PJM Load Analysis Subcommittee meeting Item #3, November, 18, 2017, available at http://www.pjm.com/-/media/committees-groups/subcommittees/las/20161118/20161118-item-03-ihs-distributed-solar-generation-forecast.ashx.

[45] PJM, *Distributed Solar Generation Update,* PJM Load Analysis Subcommittee meeting Item #3, November 18, 2016, slide 23, available at http://www.pjm.com/-/media/committees-groups/subcommittees/las/20161118/20161118-item-03-pjm-distrubuted-solar-generation-forecast.ashx.

to support the true load could be underestimated should these DER facilities underperform during critical system conditions."

Q 100: Please comment on this position.

A: DERs can be reflected as a load adjustment, or instead such resources can be treated as supply resources; either approach can accurately recognize their contribution to meeting customer loads during all conditions, including critical system conditions. But to remove the DERs entirely, as the Company recommends, would be inconsistent with sound planning practices and would result in customers having to pay more for duplicative capacity.

While it is true that DERs may underperform during critical system conditions, this is true of every single resource relied upon by the Company to serve its customers. Nuclear, coal, natural gas, hydroelectric, and every other type of resource can experience a forced outage during critical system conditions. PJM reduces the solar output to well below its nameplate capacity, in the same way that other resources' forced outage rates are reflected in planning. PJM's approach to reflecting DERs in its forecast is appropriate.

Q 101: The 2017 Plan further alleges (p. 29) that this issue reflects a difference in "reliability policy" between the Company and PJM. Please comment.

A: There is no disagreement between the Company and PJM with regard to reliability (resource adequacy) policy. The Company accepts and applies PJM's approach to determining capacity requirements, which is based on probabilistic modeling to satisfy a "one day in ten years" resource planning criterion.

Q 102: Is the Company's position on DERs supported by any analysis of the performance of such generation?

A: No. The Company states that it has not performed such analysis.[46]

Q 103: Now please comment on the Company's adjustment to PJM's forecast to add back DERs (Figure 2.3.3).

A: As with the data center adjustment, this adjustment, while not justified at all, is also applied incorrectly. The workpapers reveal that the Company's adjustment adds back, in addition to the DERs, an amount based on an arrangement with the South Eastern Power Authority that has nothing to do with solar or DERs.[47] As with the error pertaining to data centers, this error also carries forward into Figures 2.3.4 and 2.3.5.

Q 104: Third, the Company describes PJM's approach to forecasting appliance saturation and efficiency, and then claims to incorporate its forecasts based on customer surveys into PJM's modeling framework. Please comment.

A: The Company apparently takes issue with PJM's use of data and forecasts from the U.S. Energy Information Administration for the South Atlantic Census Region, as further processed by Itron and used in its forecasting, stating as follows:

> "These forecasts differ from those of the Company in that the Company relies on appliance saturation and efficiency data acquired from its own customer surveys, the most recent of which occurred during 2016. The Company uses this historical customer survey data to develop forecasts of both appliance saturation and corresponding appliance efficiency gains, which are then incorporated into the Company's load forecasting process."

Q 105: Is it correct that PJM used only information at the South Atlantic Census level for its forecast?

[46] Response to Data Request ER 2-23(a).
[47] Response to Data Request ER 8-6 supplemental.

A: No. PJM requests and receives more granular data from its many electric distribution companies, including the Company.[48]

Q 106: Was PJM able to make use of the Company's more detailed information to prepare its 2017 load forecast?

A: Yes. The Company provided data to PJM for use in its forecasting.[49] To the extent the Company may have data that is more granular or recent than what PJM uses, it is only because the Company did not provide this information to PJM.

Q 107: Are there other ways PJM's forecast differs from the Company's in regard to saturation and efficiency?

A: Yes. There are at least two substantial differences. First, PJM uses forecasts of future changes in equipment saturation and efficiency based on the U.S. government analysis and projections as processed by Itron. The Company does not use such long-term projections. Second, the Company uses intensity and saturation projections only for the residential sector, not for any of the other sectors represented in its modeling (commercial, industrial, Public Authority, street lighting, and wholesale sales).[50]

Q 108: What do you conclude with regard to PJM's approach to reflecting appliance efficiency and penetration?

A: I conclude that PJM's approach is superior to the Company's and gives more reliable results. By using long-term projections, and reflecting appliance saturation and efficiency changes in all sectors, PJM's approach is superior to the Company's.

---

[48] See, for instance, PJM, *Preliminary Load Forecast,* PJM Load Analysis Subcommittee meeting Item #7, slide 12, November 30, 2015, available a http://www.pjm.com/-/media/committees-groups/subcommittees/las/20151130/20151130-item-07-preliminary-load-forecast-presentation.ashx.

[49]

[50] Response to Data Request ER 6-13(b).

PJM's current approach was developed over an extended period with input from load forecasters from across the PJM footprint. It has been thoroughly tested and vetted, and it has reduced PJM's forecasts and improved their accuracy and consistency with trends. In this process, PJM performed substantial back-casting to ensure that the enhancements would improve forecast accuracy. In addition, PJM's approach is much more transparent than the Company's. PJM's approach takes into account the Company's data, to the extent it was provided, but adds value by using the projections based on the U. S. government research and modeling, and applying these projections to all sectors.

Q 109: Turning now to the Company's adjustment to PJM's forecast for appliance saturation and efficiency, how was this prepared?

A: The 2017 Plan states that the Company "incorporated its customer appliance and efficiency forecast into PJM's modeling framework." It is unclear how the adjustment was prepared, and the workpapers do not show the calculations.[51] However, it is apparent that this change essentially turns back the clock on PJM's carefully designed and vetted enhancements to improve its forecasts by better reflecting trends with regard to appliance efficiency and saturation.

Q 110: Finally, the Company criticizes PJM's approach for not separately forecasting government facilities. Please describe how the Company's "Public Authority" loads are captured in PJM's forecasting methodology.

A: These loads would be part of the commercial sector, and historical trends would be captured and projected based on the six-part economic variable, as with all other loads under PJM's forecasting methodology.

[51] Response to Data Request ER 1-23.

Q 111: Does the Company provide any reasons why PJM's approach would fail to capture trends in Public Authority loads?

A: No. In response to a data request, the Company provided the Public Authority loads as a fraction of total loads over the past thirty years.[52] This data suggests no trend that PJM's forecasting approach would not capture. The Public Authority loads averaged 12.7% of total loads over the thirty years, and were 12.6% in 2016. The Company does not assert that future Public Authority load growth will deviate from trend; it has performed no analysis in that regard.[53]

Nor does the Company assert that PJM's methodology fails to capture trends in Public Authority loads.[54] The Company has performed any analysis in regards to such a position.[55]

The Company does not apply any adjustment to its load forecast for Public Authority loads (which would be needed if it was felt the econometric analysis failed to correctly project these loads), nor has the Company proposed to PJM that it perform such an adjustment, as it did for data centers.[56]

Q 112: How did the Company calculate its adjustment for Public Authority loads?

A: The Plan states (p. 28) that the Company "incorporated the Public Authority Sector explanatory variables identical to those used by the Company into PJM's load forecasting framework." As with the adjustment for equipment saturation and efficiency, it is

[52] Response to Data Request ER 6-9 attachment.
[53] Response to Data Request ER 6-10(c).
[54] Response to Data Request ER 6-10(a).
[55] Response to Data Request ER 6-10(b).
[56] Response to Data Request ER 6-10(e).

unclear how the adjustment was prepared, and the workpapers do not show the calculations.[57]

Q 113: Please summarize your assessment of the Company's four "adjustments" to PJM's load forecast.

A: None of these proposed adjustments is warranted or would improve PJM's forecast. Moreover, even assuming any of the adjustments were appropriate, which they are not, the Company's adjustments contain errors that overstate the effect on PJM's forecast and render Figures 2.3.2 through 2.3.5 inaccurate. The Company's unwarranted and misapplied criticisms do not change my conclusion that PJM's forecast is likely to be accurate and the Company's is not.

VIII. CONCLUSIONS AND RECOMMENDATIONS

Q 114: Please summarize your conclusions with regard to the peak load forecast and Total Resource Requirement values used in the 2017 Plan.

A: I conclude that the Company's DOM Zone peak load values are far too high, and PJM's forecast is more accurate. In addition, the Company has overstated the DOM LSE's likely portion of that peak in future years. In its TRR calculations, the Company has improperly reflected the excess capacity cleared through PJM's RPM capacity construct. More accurate estimates of DOM Zone and DOM LSE peak loads based on PJM's forecasts, and the resulting TRR values, are shown in Table 1 above.

Q 115: Do you have recommendations with regard to the load forecasts used in future Integrated Resource Plans?

[57] Response to Data Request ER 1-23.

A: Yes. With regard to the peak load forecast, I recommend that the Commission consider requiring the following of the Company, in future plans:

1. To present recent weather-normalized peak loads for the DOM Zone and/or DOM LSE (either prepared by the Company, or by PJM), and to discuss recent trends in weather-normalized peak loads.

2. To commission a forecast of data center loads by an outside firm (as the Company did in 2013 and 2015, resulting in the reports and forecasts prepared by Quanta Technology).

3. To fully separate the forecasting of data center peak loads from the forecasting of all other customer peak loads, and to present the history and forecast of data center and other loads separately. This could be done by defining the data centers as a separate customer group with its own regression equation (as the Company now does for Public Authority loads). Alternatively, the historical data center loads could be removed from the econometric models used for all other loads, since in any case the Company states that is relies on data center forecasts that it develops applying other methods.

4. To update the estimated embedded amount of data center load reflected in the econometric forecasting annually based on the latest information.

5. To provide an explicit forecast of the peak loads of the DOM LSE as a portion of the DOM Zone peak loads (taking into account data centers and any other sectors whose growth differs substantially for DOM LSE and other DOM Zone LSEs), with a discussion of recent trends in DOM LSE and Other LSE peak loads.

6. To present alternative load forecasts determined using 20- and 10-year historical estimation periods, in addition to the longer period currently used, and to provide a discussion of the differences and of the rationale for the choice of historical period.

7. To retain an outside consultant to perform a comprehensive review of the load forecasting methodology and make recommendations for improving accuracy.

Q 116: Do you have recommendations with regard to the calculation of TRRs used in Integrated Resource Plans?

A: Yes. With regard to the calculation of TRRs, I recommend that the Commission consider requiring the following of the Company, in future plans:

1. To determine TRRs based on reserve margins needed for resource adequacy for all years (as opposed to the Company's approach using RPM results).

2. To use PJM's Forecast Pool Requirement ("FPR") values, applied to a forecast of coincident peak loads, to determine the TRRs in unforced capacity terms, consistent with how PJM allocates capacity cost. The TRRs can also be presented in installed capacity terms, if needed, by applying a DOM LSE fleet-wide average forced outage rate, again consistent with PJM's approach.

Q 117: Does this complete your testimony?

A: Yes it does.